Bruising of Midwestern Storage Onions

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Bruising of Midwestern Storage Onions

By W. R. Wright and B. A. Billeter [1]

SUMMARY

The role of bruising with respect to a watery scale condition of the hard, yellow, storage onion of the north central onion-growing area of the Midwest was explored. Artificially bruised onions showed a marked ability to "recover" from the visible effects of the injury. Such recovery was favored by room or 60° F temperature over 38°. Bruised onions were not predisposed to decay as a result of bruising. Neither harvesting, storage, nor grading practices that were observed encouraged objectionable bruising symptoms. Researchers suspect damage occurs during transit. This defect has probably been confused on occasion with translucent scale resulting from long-term storage, or with freezing injury.

INTRODUCTION

For many years a watery scale condition has been a problem for storage onions grown and shipped from the north central area of the Midwest. Shippers complain that onions loaded in good condition are downgraded and occasionally rejected by receivers because of this defect. As a result, an investigation of the problem was initiated.

Several grower-shippers, responding to a questionnaire,[2] directly or indirectly implicated injury during bulk storage, grading, and sizing processes. "Internal condensation" resulting from onion tissue reaction to removal from cold storage to the warmer environment of a trailer was one theory advanced to account for the presence of objectionable watery scale on arrival loads known to be free of the defect at the time of departure.

Freezing, watery scale, and translucent scale are very similar in appearance. The U.S. Department of Agriculture Grades and Standards notes only the first two, but, in practice, embraces the translucent scale

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[2] Compiled by L. P. McColloch, research plant pathologist (retired), Agr. Res. Serv., U.S. Dept. Agr.; distributed through the cooperation of the Federal-State shipping point inspectors.

condition under watery scale. Translucent scale is a presumably irreversible physiological disorder resulting from a disintegration of the cell walls of the parenchyma, and a complete disorganization of the cell contents; it is, furthermore, a problem identified primarily with long storage.[3] The watery scale condition under consideration has been observed throughout the season and as apparently possessing a recovery potential.

PROCEDURES

Downing Yellow Globe variety commercial run onions graded large and medium sized were obtained from Zeloski Muck Farms of Lake Mills, Wis. These onions were certified by a Federal-State inspector as being well within tolerance for grade and condition. These onions were gently transported to the Chicago Pathology Laboratory where re-examination sustained this rating. Attempts were then made to reproduce the watery scale condition through bruising. Initial results closely resembled the condition encountered on the market.

Onions were bruised by shaking them in a wooden box that had ¼-inch wooden dowels spaced 3 inches apart on the floor. The shaker box had a capacity of 5 pounds (about 10 large or 16 medium sized) of onions and was mounted on a platform actuated by a ½-hp motor to deliver a full-cycle travel length of slightly over 6 inches at 180 cycles per minute. Generally, a good gradation of bruising was obtained by a 3 to 4 minute shaker treatment. Treated lots were stored 1 to 7 days at 38° F and at a room temperature of about 75°. Each test lot had a comparable bruise control lot, usually the first test lot, which was rated immediately. Each lot also had a nontreated control likewise rated immediately. Upon completion of the prescribed storage time, treated lots were cut and rated against the original bruise control.

In another test, lots of bruised onions were placed at 60° F for 2 weeks, then transferred to 38°; other lots were immediately placed at 38°. All lots were held for 2 months. Each lot had bruise controls that were rated immediately; additionally, each lot had nonbruised controls some of which were rated immediately and the rest stored and evaluated with their respective test lots at the conclusion of the storage period.

Onions in all tests were scored for watery scale using these categories: Commercial grade (none to 1 full scale affected); damage (more than 1 full scale affected); and severe damage (more than 2 full scales affected) (fig. 1). These criteria equate to Federal Terminal Inspection standards. Decayed, doubles, or small onions were discarded before testing.

Commercial shipments of onions exhibiting a severe watery scale con-

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[3] Lipton, W. J., and Harris, C. M. FACTORS INFLUENCING THE INCIDENCE OF TRANSLUCENT SCALE OF STORED ONION BULBS. Amer. Soc. Hort. Sci. Proc. 87:341–354. 1965.

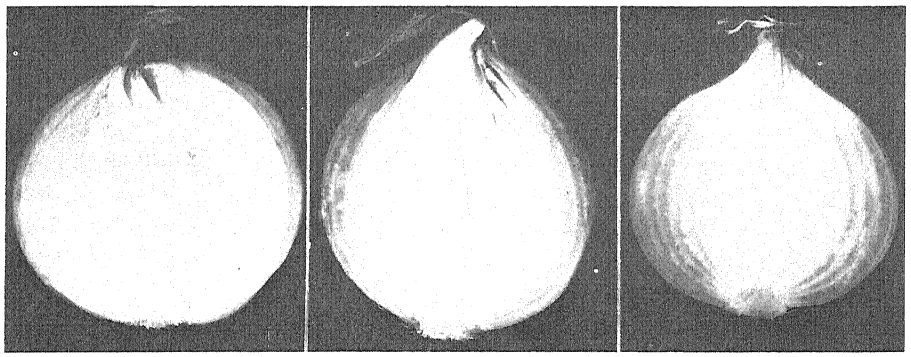

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FIGURE 1.—Categories of artificially bruised onions are, left to right, commercial (none to one full scale affected), damage (two full scales affected), and severe damage (more than two full scales).

dition, received on the market over a 2-year period, were tested for recovery potential. From a November truck shipment originating in Michigan, 12 master containers, each containing twelve 3-pound consumer polypacks, were selected at random on the day of arrival. Two polypacks from each master were examined immediately. Half the masters with their remaining consumer packs were placed at 38° F, and half were placed at room temperature. Two more consumer packs from each master were examined after 1 day, 2 days, and 7 days. Four consumer units from each master were examined after 8 days.

From a January truck shipment of Wisconsin onions reported by the receiver as showing severe watery scale, two master containers, each with twelve 3-pound consumer polypacks, were selected randomly. Three consumer packages from each master were evaluated immediately. The rest were placed at 60° F at 65 percent relative humidity. Four consumer packages from each master were examined after 1 week and 3 weeks. The remaining consumer polypacks from each master were examined after 4 weeks.

To test the theory that watery scale represented an internal condensation of the onion tissue as a result of movement from cold to a warmer environment, 22 tests were run. Onions cooled to 38° F were exposed to room temperatures for 18 and 24 hours and then examined.

A field storage test was conducted to explore the possibility that the watery scale condition might be encouraged by the widespread practice of bulk storage or time in storage, or both. Harvested onions are moved directly into bulk storage where they are piled about 14 feet deep, eventually settling to about 12 feet. The onions cure for about 2 weeks by

gas-fired heaters, which generate air heated to 85° to 90° F. This heated air is forced up through the onions by large fans via associated ducting.

For the test, thirty 100-pound bags of onions were hand harvested to minimize injury. Three sacks were utilized as controls and were examined at the initiation of the bin fill. The remaining 27 sacks were distributed in three 9-sack series at the initiation, midpoint, and conclusion of the bin storage. Each series placement consisted of three sacks each, at the left, center, and right of the bin; at locations 2 feet from the bottom, midway, and 2 feet from the top of the pile. The centrally placed sacks of all series contained 30-day Ryan recording thermometers. During the placement of the test series, samples of onions were drawn from the point of initial drop from truck to first storage conveyor, from onions freshly stored, and from onions stored 2-weeks. Samples were also taken from the commercial grading line of the storage operation when the final test series was removed. The test-sack series were removed 23, 25, and 27 weeks later with the first series in being the first series out. A 20-pound sample from each test sack was evaluated.

RESULTS

Shaker bruise tests: Tables 1 and 2 showing the results of successive seasons testing clearly reveal the recovery potential of onions from the effects of bruising. Recovery is indicated by a general increase in the per-

TABLE 1.—*Quality changes in Downing Yellow Globe onions experimentally bruised* [1] *and then held at room temperature (75° F) and at 38° F*

Holding time (days)	Commercial [2]		Damage [3]		Severe damage [4]		Number of tests [5]
	75° F	38° F	75° F	38° F	75° F	38° F	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
0: Untreated	100	100	0	0	0	0	24
0: Bruise control	48	48	27	27	25	25	67
1	55	53	29	27	16	20	20
2	74	54	17	29	9	17	28
3	83	68	10	21	7	11	26
4	100	79	0	19	0	2	10
5	95	76	5	14	0	0	22
6	96	61	4	26	0	13	4
7	96	90	4	9	0	2	110

[1] Agitated 3 to 4 minutes in shaker box with 6-inch stroke, 180 strokes per minute.
[2] Up to 1 full scale affected.
[3] More than 1 full scale affected.
[4] More than 2 full scales affected.
[5] Combined results of 5-lb test samples of both large- and medium-sized onions.

TABLE 2.—*Quality changes in Downing Yellow Globe onions from Wisconsin experimentally bruised* [1]

Treatment	Commercial [2]		Damage [3]		Severe damage [4]		Decay [5]		Number of tests [6]
	60°/38° F	38° F	60°/38° F	38° F	60°/38° F	38° F	60°/38° F	38° F	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
Untreated control [7]	100	100	0	0	0	0	0	0	9
Bruise control [7]	39	23	45	40	15	37	0	0	12
Bruising plus storage	95	95	1	1	0	0	4	4	37
Nonbruised plus storage	96	96	0	0	0	0	4	4	14

[1] Agitated 3 to 4 minutes in shaker box with 6-inch stroke, 180 strokes per minute, and held for 2 weeks at 60°, then 6 weeks at 38° or for 8 weeks at 38° F.

[2] Up to 1 full scale affected.

[3] More than 1 full scale affected.

[4] More than 2 full scales affected.

[5] Gray mold rot and bacterial soft rot.

[6] Combined results of 5-lb test samples of both large- and medium-sized onions.

[7] Immediate evaluation.

centage of commercial, and a progressive decrease in the damage and the severe categories. This trend held regardless of size or of temperature, although the rate of recovery was favored by higher temperatures. Placing bruised onions at 60° F for 2 weeks before storage had no appreciable effect on degree of recovery or on the percentage of decay developing after 2 months of storage (table 2).

Commercial truck shipments: Table 3 records the progress in recovery of a commercial truck shipment of Michigan storage onions. The pattern of generally decreasing damage and severe damage, and the increase of the commercial category persisted. Onions recovered somewhat faster at room temperature than at 38° F. This pattern was repeated in the test with the Wisconsin commercial truck shipment (table 4).

"Condensation" theory tests: None of the onions in the tests of the condensation theory developed a watery scale condition.

Bulk storage test: Samples from the 9-sack test placed in storage and recovered 23 weeks later revealed a 3-percent damage category from watery scale in the middle-layer sacks, and 2 percent in one of the bottom-layer sacks. All others were rated commercial. The sacks recovered 25 weeks following storage showed 1 percent severe damage from watery scale in the center sack of the middle layer, possibly from contact with the temperature recording instrument; the rest were commercial grade. The third test sacks recovered 27 weeks from the time of storage disclosed 1 percent decay and 3 percent damage characteristic of translucent scale in a middle-layer sack. The rest were commercial watery scale.

TABLE 3.—*Quality changes in a commercial truck shipment of Michigan storage onions affected by watery scale* [1] *held at room temperature (±75°) and at 38° F*

Holiday time (days)	Commercial		Damage		Severe damage		Test [1] packages
	75° F	38° F	75° F	38° F	75° F	38° F	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*
Initial examination	50	50	30	30	20	20	24
1	51	64	25	22	24	14	12
2	85	64	11	22	4	14	36
7	99	79	1	14	0	7	36
8	98	83	2	10	0	7	36

[1] 3-pound consumer packages.

Ryan tape temperature readings for the three test placements revealed initial temperature range from 78° for the first test in, to 59° for the final test in; and after 25 days, final readings ranged from 65° for the initial test in (and first test out), to 52° for the final test. The warmest temperatures were consistently recorded in the top layer test bags; the coolest were found in the bottom test bags. Hand temperatures of onions taken at the time of removal ranged from 42° to 47° F.

Onions from the control sacks, those taken from the packout conveyor line, and all of the auxiliary samples withdrawn at the initiation of the storage test proved to be of commercial grade with the exception of the truck-to-conveyor samples which had 4 percent watery scale in the damage category.

DISCUSSION

This study indicates that the hard, yellow globe storage onion is capable of a considerable degree of recovery from watery scale caused by

TABLE 4.—*Quality changes in a commercial truck shipment of Wisconsin storage onions affected by watery scale condition held at 60° F*

Holding time (weeks)	Commercial	Damage	Severe damage	Test [1] packages
	Percent	*Percent*	*Percent*	*Number*
Initial examination	57	20	23	6
After 1	96	3	1	8
After 3	97	0	3	8
After 4	86	4	10	2

[1] 3-pound consumer packages.

bruising. This capability, also noted by Ringel and others [4] may explain why onion loads arriving at terminal markets with enough watery scale to throw them out of grade may be well within tolerance upon shipper-requested reinspection. This creates a situation that is baffling and irritating to shipper, receiver, and inspector alike.

Apparently most of this damage occurs in transit, because onion samples going into storage, during storage, or coming out of storage revealed little evidence of commercially objectionable watery scale. Even onions with deeply depressed areas resulting from pressure of adjacent onions during storage showed no evidence of this defect.

Freezing and translucent scale,[5] and the watery scale caused by bruising are similar in appearance. Notation of the location of the injury in the load, the arrival temperature, the physical evidence of ice crystals in the tissues, or the soft wet condition of onions severely frozen and thawed are the practical clues to freezing for the terminal inspector. The absence of injury at locations in the truck normally conducive to freezing, normal arrival temperatures, intermittent scale injury (usually the second and third, or the first and fourth, fleshy scales), prominent vascular network in the cleared area of the injured scale, and appearance late in the storage season will indicate translucent scale. Watery scale from bruising may occur throughout the load, although it has been observed as being occasionally more severe over the rear axle. The condition may be noted throughout the shipping season and in the absence of freezing indicators. Scales are affected progressively from the outside in, in contrast to freezing and translucent scale which may show intermittent scale damage.[3] [6] There will be borderline cases, but these suggestions should aid the inspector in arriving at a decision.

Storage tests with onions showing varying degrees of watery scale induced by bruising reveal that onions are capable of recovery from relatively severe injury. A similar recovery response by onions from two commercial truck shipments of onions suggests that watery scale from bruising may be more an important arrival defect in some seasons than either translucent scale or freezing. Onions have been reported as being capable of recovery from light freezing;[6] however, the absence of any freeze indicators and the severity of damage from which recovery was affected suggest that the watery scale condition in the commercial truck loads was the result of bruising.

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[4] Ringel, S. M., Kaufman, J., Ceponis, M. J., and Langlois, R. W. SOME QUALITY CHANGES IN ONIONS DURING MARKETING. U.S. Dept. Agr., Agr. Mktg. Serv. AMS–488. 1962.

[5] Smith, M. A., McColloch, L. P., and Friedman, B. A. MARKET DISEASES OF FRUITS AND VEGETABLES. U.S. Dept. Agr., Agr. Handb. No. 303, 1966.

[6] Wright, R. C. SOME EFFECTS OF FREEZING ON ONIONS. U.S. Dept. Agr. Circ. 415. 1927.

Bulk storage onion tests failed to reveal a relationship between either the time or position of onions in storage with the appearance of watery scale, and the indictment of bulk storage as encouraging watery scale is not substantiated.

These findings are directed toward the storage onion variety Downing Yellow Globe. Further tests are necessary to judge the applicability of the findings to other varieties, or onions grown in other geographical areas.

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